CHEMICALS

Project Fact Sheet

MEMBRANES FOR CORROSIVE OXIDATIONS

BENEFITS

- Reduced transportation and distillation requirement for hydrogen peroxide production
- Reduced steam consumption in distillation
- Significant heat and electrical energy savings

APPLICATIONS

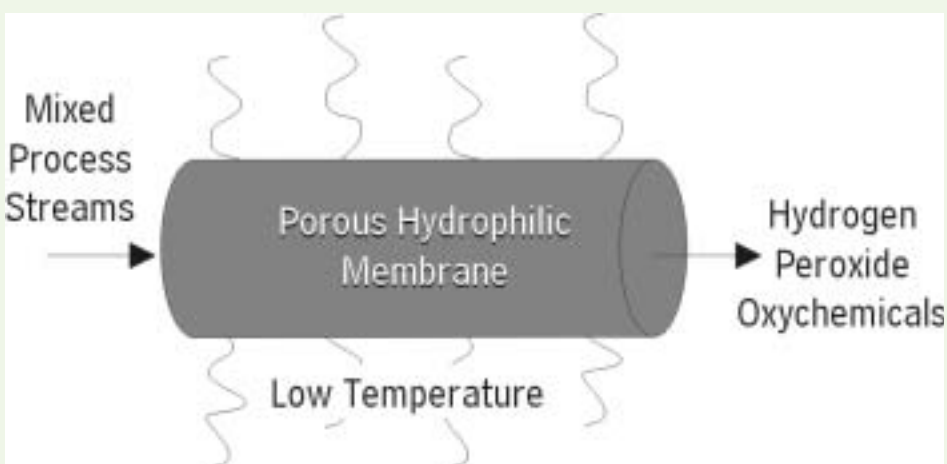
In addition to hydrogen peroxide and other oxychemicals production, the membranes could become applicable to fuel cell technology, nanofiltration, and separations in other harsh reactive conditions.

CUTTING EDGE POROUS MEMBRANES MINI-PLANT COULD ALLOW ON-SITE HYDROGEN PEROXIDE

Hydrogen peroxide is widely used in pulp and paper applications, environmental treatment, and other industries. Virtually all hydrogen peroxide production is now based on a process featuring catalytic hydrogenation followed by auto-oxidation of suitable organic carrier molecules. This process has several drawbacks, particularly in the extraction phase. One general disadvantage of this technology is that hydrogen peroxide must be produced at large centralized plants where it is concentrated to 70% purity by distillation, and then transported to the users' plant sites where it is substantially diluted before use.

Advanced membranes have the potential to enable more efficient, economic, and safe manufacture of hydrogen peroxide. Advanced membrane technology would allow filtration-based separation to replace the difficult liquid-liquid extraction based separation step of the hydrogen peroxide process. This would make it possible for hydrogen peroxide to be produced on-site in mini-plants at 30% concentration and used at the same plant location without distillation and transportation. As a result, production could become more cost-effective, safe and energy efficient. In fact, energy savings of 6.6 million Btu per ton of hydrogen peroxide could be realized with this technology.

SCHEMATIC OF MEMBRANE SEPARATION PROCESS



High throughput screening apparatus rapidly tests activity and selectivity of heterogeneous catalysts.

Project Description

Goal: To develop porous hydrophilic membranes that are highly resistant to oxidative and corrosive conditions and to deploy them for recovery and purification of high tonnage chemical such as hydrogen peroxide and other oxychemicals.

Any potentially useful membrane for separations technology has to be stable under highly oxidative and corrosive conditions and maintain high fluxes and selectivities. Perfluorinated ionomers such as Nafion are extremely stable under such conditions; this material is also hydrophilic. However, all of these Nafion or other perfluorinated ionomer materials and membranes are non-porous. If these membranes or materials could be made porous or if existing porous hydrophilic membranes could be protectively coated with the perfluorinated ionomer while still maintaining porosity, then they could be used for separation based on pressure filtration and hydrophilic interactions, with high flux and low energy requirements. This research project aims to determine this possibility.

Progress & Milestones

Over the past two years, the project partners have been working on various aspects of technologies to develop efficient, safe, and economical processes for hydrogen peroxide and its derivative chemicals. Two patent applications have been filed; one has been issued, and the other is pending. The highlights of this completed research are:

1. Achievement of "true" porosity in perfluorinated ionomer (Nafion) membranes by a novel method thus making a novel porous membrane material.
2. Determination of structure and morphology of such materials by the Intense Pulsed Neutron Source (IPNS) at Argonne National Lab.
3. Showing that this and other porous hydrophilic membranes can separate water, hydrogen peroxide and other dissolved hydrophilic chemicals from a hydrocarbon phase by simple pressure filtration.
4. Demonstration of a phenomenon termed "wicking effect" wherein the flux of the aqueous phase through these porous hydrophilic membranes are not substantially decreased even as the aqueous to hydrocarbon phase ratio becomes very low.

Research will continue on the:

- Development, optimization and testing of porous perfluorinated ionomer (Nafion) membranes and materials.
- Development, optimization and testing of coated porous hydrophilic membranes with stable perfluorinated ionomer coatings.
- Construction and performance testing of lab-scale modules.

Commercialization

UOP is a highly respected international company that has developed, licensed, and commercialized many important processes in the petroleum, chemical, food, and other process industries. They will assist with the demonstration, scale-up, and commercialization of the membrane technology, which is expected to take 3 to 5 years.

Project Partners

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